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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁴ : A63B 69/00, 69/12		A2	(11) International Publication Number: WO 87/ 05229 (43) International Publication Date: 11 September 1987 (11.09.87)
(21) International Application Number: PCT/GB87/00141 (22) International Filing Date: 27 February 1987 (27.02.87) (31) Priority Application Numbers: 8605054 8606196 (32) Priority Dates: 28 February 1986 (28.02.86) 13 March 1986 (13.03.86) (33) Priority Country: GB (71) Applicant (for all designated States except US): SCIENTIFIC APPLIED RESEARCH (SAR) PLC [GB/GB]; 27 Northolt Road, Harrow, Middlesex HA2 0LS (GB). (72) Inventor; and (75) Inventor/Applicant (for US only) : JOHNSON, William, Nevil, Heaton [GB/GB]; 2 Mulberry Close, Hampstead, London NW3 (GB).		(74) Agent: HOWDEN, Christopher, A.; Forrester, Ketley & Co., Forrester House, 52 Bounds Green Road, London N11 2EY (GB). (81) Designated States: AT (European patent), AU, BB, BE (European patent), BG, BJ (OAPI patent), BR, CF (OAPI patent), CG (OAPI patent), CH (European patent), CM (OAPI patent), DE (European patent), DK, FI, FR (European patent), GA (OAPI patent), GB (European patent), HU, IT (European patent), JP, KP, KR, LK, LU (European patent), MC, MG, ML (OAPI patent), MR (OAPI patent), MW, NL (European patent), NO, RO, SD, SE (European patent), SN (OAPI patent), SU, TD (OAPI patent), TG (OAPI patent), US. Published Without international search report and to be republished upon receipt of that report.	
(54) Title: DEVICE FOR USE BY SPORTSMEN AND SPORTSWOMEN			
(57) Abstract			
<p>A device for use by sportsmen and sportswomen in assessing performance and training, and preferably adapted to be strapped to the wrist like a wrist watch includes means for emitting sounds, such as pace-making signals, or start signals indicating the beginning of timed periods, and input means such as a push-button or buttons, whereby the user can provide signals to the device to set the device or enter data such as pace or stroke rate pace length. The device preferably can also count the number of paces run or strokes swum, and calculate distance covered, mean speed and so on. In a variant, the device may incorporate a sensor for sensing when individual swimming strokes are made or paces made in running.</p>			

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FI	Finland				

Title: "Device for use by sportsmen and sportswomen"

THIS INVENTION relates to a device for use by sportsmen and women in assessing their performance.

5 According to one aspect of the invention there is provided a device for use by, for example, sportsmen and sportswomen in assessing performance, incorporating means for emitting sounds to communicate information to the user, and means whereby the user can provide signals to the device, the device incorporating means for performing a counting and/or timing function related to the particular activity concerned, and for actuating said
10 sound emitting means in correlation with the carrying out of said function.

In a preferred embodiment, there is provided a device for use by sportsmen or sportswomen in training and incorporating means for emitting audible signals in a predetermined sequence and at pre-determined intervals
15 following a manual triggering operation to simulate a race-start sequence, and means for initiating timing of a period elapsing from a predetermined signal in said sequence, until a further stop-signal supplied subsequently to the device.

20 The device may be adapted to be secured to the user's body and may incorporate sensing means for sensing movements made by the user in carrying out the particular activity concerned, for example for detecting the execution of successive strokes by a swimmer or the making of successive paces by a runner, and means for counting the number of
25 successive strokes, paces, or the like, executed.

Thus, according to another aspect of the invention there is provided a device for use by swimmers in assessing performance, the device being adapted to be secured to a swimmer's body and incorporating sensing means
30 for sensing movements made by the swimmer in swimming and thereby

detecting the execution of successive strokes, and means for counting the number of successive strokes executed.

5 The sensing means may, according to this aspect, be sensitive to the orientation of the force of gravity relative to the device, whereby the execution of successive strokes may be determined by changes in the orientation with respect to the vertical part of the swimmer's body to which the device is attached, during each stroke.

10 Alternatively, or in addition, the sensing means may be sensitive to accelerational or decelerational forces arising from the movements of the device, and the part of the swimmer's body to which the device is attached.

15 The sensing means may include a two sensors, a first one of which is sensitive to the orientation of the force of gravity relative to the device and the second of which is sensitive, for example, to accelerational or decelerational forces. The first sensor may be utilised, for example, for strokes in which the arms of the swimmer move in a manner which approximates roughly to rotation about a horizontal axis, for example the freestyle
20 or crawl stroke. The second sensor may be utilised for strokes in which the inclination of the swimmers limbs relative to the vertical may vary in a less pronounced manner, for example the breast stroke.

25 The first sensor, in this instance, may comprise, for example, a small weight, such as a metal ball, guided for free movement between limiting positions, in one of which the weight operates a detector to provide a signal, so that each time the weight moves to said one limiting position a respective signal is produced. The weight may comprise, for example, a pivotally mounted weight, a metal ball confined within a tube or the like
30 arrangement. Thus, assuming the device to be attached to the swimmer's wrist, for every stroke which the respective arm completes, the weight will be moved to said one limiting position at least once during every stroke to operate the detector and produce a respective signal.

35 The second sensor, sensitive to acceleration or deceleration of forces, may likewise comprise a weight mounted for movement between the limiting positions, but in this instance urged towards a predetermined

position by a spring or the like so that only when the device is subjected to acceleration or deceleration can the weight be moved from its normal position to operate a detector. Alternatively, the first and second sensors may be constructed virtually without moving parts, for example being
5 constructed as an electronic load-sensing device such as a piezo-electric cell, strain gauge or the like with a small weight mounted thereon.

Provision may be made whereby the swimmer can select, by operation of said input means, which of the two sensors is effective to
10 determine when a stroke has been executed. However, it will be appreciated that it is possible for both sensors to remain effective whenever the device is in use and for the device to incorporate processing means whereby the signals produced by the two sensors and the variations of these
15 signals with time, and the inter-relationship of these signals to one another can be analysed, to provide a reliable detection of the execution of a stroke. For example, the arrangement may be such that the device may be placed by operation of the input means, in a calibrating state in which the
20 substantially repeating cycle of signals produced by the sensors during the execution of repeated strokes in swimming in a particular style is recorded, whereafter the device may be set in a normal state in which repetition of
each cycle of the corresponding sequence will be interpreted by the processing means as the detection of the execution of a respective complete stroke.

25 Other means of detection may be utilised, of course. For example the device may incorporate a light sensor, a sensor of the dielectric constant of the medium around the device, a pressure sensor or the like whereby fluctuation in these quantities during swimming, e.g. as a swimmer's arms are withdrawn from and returned to the water, will provide
30 a detection of the execution of a stroke.

Where the sensors operate substantially by sensing accelerational or decelerational of forces, they may be so contrived as to be capable of detecting the slight impact produced by the swimmer's limbs breaking the
35 water surface. Likewise such sensors may be arranged to detect the somewhat sharper impact which may be produced either deliberately or as a matter of course by the swimmer striking the end of the pool at the

completion of a length, with the device being arranged to count individual lengths swum instead of, or in addition to, individual strokes executed.

5 The device, using signals from the timing means and from the sensors, is able to calculate time related quantities such as stroke rate, elapsed time, etc., as will be apparent from the examples given in relation to modes (a) to (h) below.

10 In a preferred embodiment of the invention, in either aspect, the device is in the form of a small unit provided with a strap whereby it can be attached to one of the user's limbs, or with a suitable clip whereby the device may be attached to the user's clothing, for example to a swimming costume.

15 The device may be an electronic device with a self-contained power supply, a display, and input means, for example in the form of a manually operable push button or buttons, whereby the device may be operated in different modes and/or data may be entered into the device, as set out in detail below. In embodiments intended for use in watersports, the device
20 is, of course, appropriately waterproofed. The device preferably has the outward form of a wrist-watch and has a time-piece function so that it may be used as a watch in everyday use.

25 In some forms, the device may incorporate sensing means, for sensing when successive swimming strokes have been executed, or successive paces, paddle strokes or the equivalent have been made, depending upon the activity concerned. Furthermore the device may include timing means, manually operable input means, processing means arranged to receive signals from the sound emitting means, timing means and input means, and a
30 display driven by the processing means. The display may be a digital electronic display, for example an LCD display, of the kind commonly used in digital electronic watches.

35 The device, using signals from the timing means and from the sensors, is able to calculate time related quantities such as stroke rate, elapsed time, etc., as will be apparent from the examples given below.

As will be apparent from the above and what follows, several of the preferred modes of operation of the device require the provision, to the processing means, of information to be provided by the user. Such information is preferably carried in the device in digital form in an electronic memory, and by appropriate operation of the input means (push buttons or the like) the device may be placed in a selected one of a series of calibrating states in each of which a respective quantity may be entered in the appropriate area in the memory. The calibration system adopted may be similar to that utilised in time setting in digital electronic watches, with the display indicating a number advanced automatically so that the desired number can be entered simply by pressing or releasing a button when the desired number is shown on the display, with the display also providing an indication of what quantity is currently under calibration.

By way of non-limiting example, the device may be capable of operating in any one of the following modes:-

- a) on the basis of a pool length, lap length or the equivalent, entered via the calibration facility, to calculate and display strokes, paces or the like per unit distance, (on the basis of the stroke count, pace count or the like occurring in the time lapsing between successive signals provided when the user begins to cover a predetermined length and completes that length, for example on the basis of the stroke count occurring in the time lapsing between successive signals provided when a swimmer leaves one end of a swimming pool and when he reaches the other end of the pool);
- b) stroke rate, pace or the like rate (strokes or paces or the like executed per unit of time or time per given number of strokes or paces);
- c) overall elapsed time (e.g. between signals provided by the user, for example on leaving one end of the pool and on reaching the other end);
- d) given a predetermined number of lengths, laps or the equivalent entered via the calibration facility, to indicate the overall time

required to complete the number of lengths or laps entered (on the basis of signals provided at the completion of each length or lap);

5 e) to operate an audible alarm at a pre-set time after a starting signal, whereby a swimmer or runner, for example, can set a target time for a given distance and will be advised, by triggering of the alarm, as to whether or not, and by what amount, he has failed to reach the target set;

10 f) on the basis of a given distance covered per stroke, pace or the like executed, (or, for example, per hundred strokes, paces or the like executed), entered in the device using the calibrating facility, to calculate and display the total distance covered, based upon the number of strokes, paces or the like executed;

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g) to operate as a stop watch;

h) to operate as a normal time-piece to indicate time of day.

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The device may incorporate sensing means for sensing physiological quantities such as the heart rate of the wearer, and may have a facility for calculating and displaying, on the basis of pre-set information, as well as the total strokes or lengths swum etc., or total paces or distance covered etc., the total number of calories used in a swimming, running or the like session.

25

The device may also include means for sensing the temperature of the environment in which the device is located, e.g. temperature of the water during swimming or, where the device is worn as a normal watch at other times, the temperature of the surroundings. The device may also, where intended for use by swimmers, include a water pressure sensor, with the device, in a further mode, being arranged to give readings of depth under the water surface. Such a pressure sensor may also form the basis of a means used for sensing execution of successive strokes in swimming.

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Where an alarm facility is provided, the device in one mode, may operate the alarm when a pre-set number of strokes, or a pre-set number of lengths have been swum. The alarm may also be used as an ordinary alarm when the device is used as a conventional timepiece.

The device may incorporate a sound-emitting facility the use of which is not restricted to the provision of an audible alarm and which may be used for pace-setting and for otherwise signalling to the swimmer, as set out below.

5

Thus, the device may be arranged to operate in the following modes:-

- 10 (i) a mode in which, after being triggered by, for example, the wearer pressing a button, the device, after a short delay of, for example, about five seconds, emits a first audible tone or "beep", about a second later emits a further audible tone or "beep" and, about a further second after that, emits a final tone or "beep". In this mode, the first, second and third tones correspond respectively with the starter's "ready", "set", and the report of the starting pistol at the beginning of a race. Accordingly, the sportsman may train himself in, for example starting in races by operating the triggering button; then readying himself to begin running, for example, or, in the case of a swimmer, to dive in and to begin swimming promptly on the occurrence of the third tone. In this mode, the timing or "stopwatch" facility in the device commences its timing operation in exact synchronism with the occurrence of the third tone and is arranged to terminate its timing operation upon a further input signal being supplied to the device, which may be done, for example, by an appropriate sensor arranged to sense, for example, the impact of a swimmer's hand on the end of the pool, as detected by a built-in sensor or a sensor pad attached to the wearer's wrist, for example, or by an appropriate control operable in some other way by the user. In this mode, the device may have the facility for the user to enter a predetermined distance which he intends to cover. Thus, when this facility is incorporated in the embodiment intended for use by a swimmer, the device will, for timing purposes, ignore the stroking of the swimmer's hand at the end of a length apart from that occurring at the end of the last length of the pre-set number;
- 20
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- 30
- 35 (j) a mode in which the device emits audible tones or "beeps" at regular intervals of selected duration. Using the device in this mode, the swimmer makes his strokes or a runner his paces, for example, in

time to the audible tones. In this mode, the device may count the audible tones emitted and treat these as corresponding with strokes, paces or the like made, so that it is unnecessary to provide means for actually sensing the making of strokes, paces or the like by the user.

5 On the assumption that the user is adhering to the pace set by the device, the device may be arranged, on the basis of a distance entry entered manually and on the basis of the number of strokes, paces or the like (i.e. tones or "beeps" emitted) in covering that distance, to calculate how many feet are covered per stroke, pace, or the like by

10 the user at this particular pace. The device may, on this basis, calculate approximately the total distance covered by the user whilst adhering to that particular stroke, pace or the like rate, or even mean speed at that rate, or time taken to cover a pre-set distance at that particular rate. On this basis, it is relatively simple for the

15 user, by keeping appropriate records, to determine what is, for him, the best pace, stroke or the like rate for covering a particular distance. Indeed, the device itself may incorporate a facility for maintaining such a record and for displaying the recorded data, or even calculating and displaying, on demand, the optimum stroke, base

20 or the like rate based on the data previously recorded;

(k) a mode in which the device will count the number of lengths swum or laps covered by the wearer. Thus, when the user reaches the end of a length of a swimming pool being swum, or completes a lap of a

25 running track he may operate a simple, operable control facility to generate a count signal to be counted by the device as another length swum, lap covered, or the like. For example, in an embodiment of the device intended for use by a swimmer, when the swimmer reaches the end of a length of the pool, he may, for example, slap his wrist on

30 the end of the pool so that a pad worn around the wrist or on the watch senses the resultant impact and generates a count signal to be counted by the device as another length swum. The watch may furthermore be arranged to be set to a pre-set number of lengths or laps and to emit a predetermined audible signal when the user has,

35 for example, covered half of the set distance or some other fraction of the set distance or every time the user has covered a further predetermined fraction of the set distance, for example at every

successive fifth of the set distance covered. When operating in this mode, the device may be arranged to emit a continuous tone or a continuous series of rapid tones during covering of the last length or lap to indicate to the user that he is reaching the end of the pre-set distance;

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- (l) a mode in which, after manual entry into the device of information corresponding to the length of a pool to be swum or a lap of a track, the device will calculate and display the total distance swum between a start operation and a stop operation;

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- (m) a mode in which, after manual entry of the length of the pool to be swum, or of the perimeter of a track to be run, or the like, the device will emit an audible tone to signify that the desired distance has been covered. This facility may, of course, be combined with the pace-making facility referred to above and the timing facility so that the device will advise the user when he has completed a pre-set distance and will at the same time indicate the time taken to cover the pre-set distance. In the case of a device intended for use by swimmers, the device will preferably perform this function even if, at the completion of the pre-set distance, the swimmer is intermediate the ends of the pool;

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- (n) a mode in which it is possible for the user to set a target time for covering, for example a given number of lengths of a swimming pool or a given number of laps of a running track, and in which the device, after going through the "start" sequence of mode (i) above, proceeds to time out the pre-set target time and emits audible tones at the instants at which, for example, the fourth length, lap or the equivalent should have been covered, the fifth length, lap or the like should have been covered and so on, so that the user will know when he is falling behind or ahead of his target time. In this mode, the device may simultaneously keep a record of the number of lengths swum, laps covered, or the like, and may display, during swimming, running or other distance covering activity, the number of laps, lengths or the equivalent already covered and, possibly, a symbol signifying whether the user is ahead of or behind his target time.

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CLAIMS

- 5 1. A device for use by, for example, sportsmen and sportswomen in assessing performance, incorporating means for emitting sounds to communicate information to the user, and means whereby the user can provide signals to the device, the device incorporating means for performing a counting and/or timing function related to the particular activity concerned, and for actuating said sound emitting means in correlation with
10 the carrying out of said function.
- 15 2. A device for use by, for example, sportsmen and sportswomen, in assessing performance, the device being adapted to be secured to the user's body and incorporating means for emitting audible signals at selectable intervals to define a desired stroke, pace or the like rate, and means for counting the number of such audible signals emitted as a count of the strokes, paces or the like made by the swimmer.
- 20 3. A device for use by, for example, sportsmen and sportswomen in assessing performance, the device being adapted to be secured to the user's body and being arranged to emit audible signals at the elapse of successive predetermined fractions of a pre-selectable time period.
- 25 4. A device for use by sportsmen or sportswomen in training and incorporating means for emitting audible signals in a predetermined sequence and at pre-determined intervals following a manual triggering operation to simulate a race-start sequence, and means for initiating timing of a period elapsing from a predetermined signal in said sequence, until a further stop-signal supplied subsequently to the device.
30
- 35 5. A device for use by swimmers in assessing performance, the device being adapted to be secured to a swimmer's body and incorporating sensing means for sensing movements made by the swimmer in swimming and thereby detecting the execution of successive strokes, and means for counting the number of successive strokes executed.

5 6. A device according to claim 5 wherein said sensing means is sensitive to the orientation of the force of gravity relative to the device, whereby the execution of successive strokes may be determined by changes in the orientation with respect to the vertical part of the swimmer's body to which the device is attached, during each stroke.

10 7. A device according to claim 5, wherein said sensing means is sensitive to accelerational or decelerational forces arising from the movements of the device, and the part of the swimmer's body to which the device is attached.

15 8. A device for use by swimmers in assessing performance, the device being adapted to be secured to a swimmer's body and incorporating detecting means for detecting the execution of successive strokes, and means for counting the number of successive strokes executed.

20 9. A device for use by swimmers in sensing performance, the device being adapted to be secured to a swimmer's body and incorporating means for emitting audible signals at selectable intervals to define a desired stroke pace, and means for counting the number of such audible signals emitted as a count of the strokes made by the swimmer.

25 10. A device for use by swimmers in sensing performance, the device being adapted to be secured to a swimmer's body and being arranged to emit audible signals at the elapse of successive predetermined fractions of a pre-selectable time period.

30 11. A device for use by swimmers in training and incorporating means for emitting audible signals in a predetermined sequence and at pre-determined intervals following a manual triggering operation to simulate a race-start sequence, and means for initiating timing of a period elapsing from a pre-determined signal in said sequence, until a further stop-signal supplied subsequently to the device.

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(54) Title: DEVICE FOR USE BY SPORTSMEN AND SPORTSWOMEN (57) Abstract A device for use by sportsmen and sportswomen in assessing performance and training, and preferably adapted to be strapped to the wrist like a wrist watch includes means for emitting sounds, such as pace-making signals, or start signals indicating the beginning of timed periods, and input means such as a push-button or buttons, whereby the user can provide signals to the device to set the device or enter data such as pace or stroke rate pace length. The device preferably can also count the number of paces run or strokes swum, and calculate distance covered, mean speed and so on. In a variant, the device may incorporate a sensor for sensing when individual swimming strokes are made or paces made in running.		

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FI	Finland				

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 87/00141

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) * According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC ⁴ : A 63 B 69/00; A 63 B 69/12		
II. FIELDS SEARCHED		
Minimum Documentation Searched *		
Classification System	Classification Symbols	
IPC ⁴	A 63 B	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched *		
III. DOCUMENTS CONSIDERED TO BE RELEVANT *		
Category *	Citation of Document, ¹¹ with Indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	DE, A, 3131585 (R. VOGEL) 16 June 1982, see page 3, line 9 - page 4, line 15 --	1
X	DE, A, 3009414 (R. BOSCH GmbH) 17 September 1981, see page 5, line 5 - page 6, line 4 --	1
X	US, A, 4283712 (R. GOODY) 11 August 1981, see column 1, lines 43-55 --	1,2
X	US, A, 4220996 (T. SEARCY) 2 September 1980, see column 2, lines 18-57 --	1,2
A	US, A, 4164732 (E. PISCHIERA) 14 August 1979 --	
A	US, A, 3882480 (R. GREBER) 6 May 1975 -----	
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>* Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p> </div> </div>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
18th June 1987	14 SEP 1987	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	M. VAN MOL	

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹

This International search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim numbers because they relate to parts of the International application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☒ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ²

This International Searching Authority found multiple inventions in this International application as follows:

Claims 1,2,9

Claims 1,3,10

Claims 1,4,11

Claims 5-8

See PCT Form ISA/205 dated 3rd July 1987

1. ☐ As all required additional search fees were timely paid by the applicant, this International search report covers all searchable claims of the International application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this International search report covers only those claims of the International application for which fees were paid, specifically claims:
3. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers: 1,2,9
4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO. PCT/GB 87/00141 (SA 16310)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 24/08/87

The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-A- 3131585	16/06/82	None	
DE-A- 3009414	17/09/81	None	
US-A- 4283712	11/08/81	None	
US-A- 4220996	02/09/80	None	
US-A- 4164732	14/08/79	None	
US-A- 3882480	06/05/75	None	